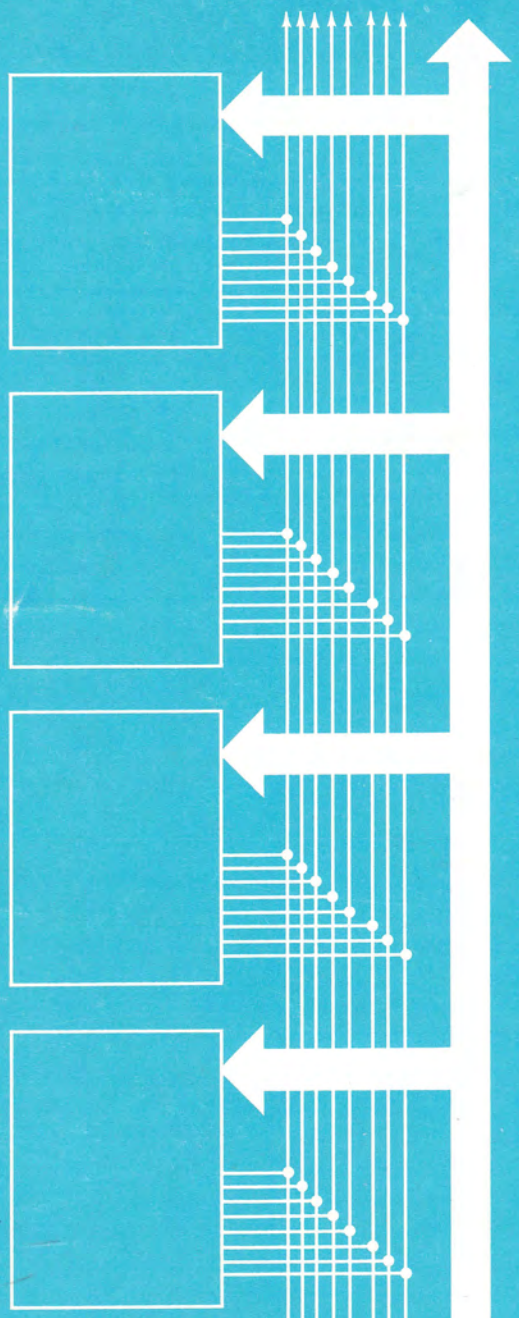
BOONTON BOONTON



R.F. Millivoltmeters
Microwave Power Meters
F.M./A.M. Modulation Meters
F.M./A.M./Φ.M. Signal Generators
Capacitance Bridges & Meters
Inductance Meters
R.M.S. Voltmeters
Accessories

CATALOG 148

Model Reference

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Options

Model Number Suffix	Description
10A	**IEEE-488 Bus Interface Module**
	For use with:
-01*	Model 42BD Microwattmeter
-02*	Model 62AD Inductance Meter
-03*	Model 72BD Capacitance Meter
-04*	Model 92BD RF Millivoltmeter
-05*	Model 93AD RMS Voltmeter
-06*	Model 42CD Microwattmeter
	** Only one option may be installed at the same time*
34A	**Resonant Coaxial Line**
-01	Slotted Center Conductor
42B	**RF Microwattmeter**
-08	Rear Signal Input
-11	Power Scale Uppermost
42BD	**RF Microwattmeter**
-01	Autoranging
-08	Rear Signal Input
-09	dBm Display
-21	Buffered BCD Series/Parallel Converter
42C	**RF Microwattmeter**
-08	Rear Signal Input
-11	Power Scale Uppermost
42CD	**RF Microwattmeter**
-01	Autoranging
-08	Rear Signal Input
-09	dBm Display
-21	Buffered BCD Series/Parallel Converter
62AD	**Inductance Meter**
-21	Buffered BCD Series/Parallel Converter
72B	**Capacitance Meter**
-03	100 mV Test Level
-05A	50 μs Output Response Time

Model Number Suffix	Description
72BD	**Capacitance Meter**
-03	100 mV Test Level
-05A	50 μs Output Response Time
-21	Buffered BCD Series/Parallel Converter
76A	**Capacitance Bridge**
-01*	IEEE-488 Bus Interface (GPIB)
-02*	Parallel BCD Data Outputs
-03	0–200 V Programmable Bias Supply
-04*	RS 232C Interface
	** Only one option may be installed at the same time*
82AD	**FM-AM Modulation Meter**
-01A	IEEE-488 Bus Interface (GPIB)
-03	RF Fuse
-04	Rear RF Input
92B, 92B-S5 and 92C	**RF Millivoltmeters**
-04	dBV Scale Uppermost
-06	75 Ω dBm Scale Uppermost
-08	Rear Signal Input
-12	dBmV Scale Uppermost
92BD	**RF Millivoltmeter**
-01	Autoranging
-08	Rear Signal Input
-09	50 Ω dBm Display
-10	75 Ω dBm Display
-12	75 Ω dBmV Display
-21	Buffered BCD Series/Parallel Converter
93A	**RMS Voltmeter**
-03	dBV Scale
-05	75 Ω dBm Scale
-08	Rear Signal Input
-18	50 Ω dBm Scale
93AD	**RMS Voltmeter**
-01	Autoranging
-08	Rear Signal Input
-09	50 Ω dBm Display
-10	75 Ω dBm Display
-15	600 Ω dBm Display
-16	BCD Series/Parallel Converter
-17	dBV Display

Model Number Suffix	Description
102E	**FM-AM Signal Generator**
-01	Rear RF Connector
-12A	Variable Frequency Modulation Oscillator
-20	Additional Frequency Band 520 MHz to 1040 MHz
-24	Pulse Modulation
102F	**FM-AM Signal Generator**
-01	Rear RF Connector
-20	Additional Frequency Band 520 MHz to 1040 MHz
-24	Pulse Modulation
103C and 103D	**FM-AM Signal Generators**
-01	Rear RF Connector
1020 and 1021	**FM-AM Signal Generators**
-01	Rear-Panel RF Output
4200	**RF Microwattmeter**
-01A	IEEE-488 Bus Interface
-03	Second Input Channel
-04	Rear Inputs
8210	**FM-AM Modulation Meter**
-01	30 kHz Low-pass Filter Version
9200A	**RF Millivoltmeter**
-01A	IEEE-488 Bus Interface
-03	Second Input Channel
-04	Rear Inputs

Warranty

Boonton Electronics Corporation warrants its products to the original purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to active devices that have given normal service, to sealed assemblies which have been opened or to any item which has been repaired or altered without our authorization.

We will repair, or at our option, replace any of our products which are found to be defective under the terms of this warranty.

*There will be no charge for parts, labor, or forward and return normal ground transportation during the first three months of this warranty.**

*There will be no charge for parts, labor, or return normal ground transportation during the fourth through twelfth month of this warranty.**

Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

**For overseas shipments, there will be no charge for Air Freight during these specified time periods.*

RF Millivoltmeter
Model 9200A

Model 9200A is a microprocessor-controlled rf millivoltmeter, that measures rf voltage from 200 μV to 300 V in the 10 kHz to 1.2 GHz frequency range. Performance features and operating conveniences, not previously available, make this a unique instrument, whether under manual or bus control.

TWO CHANNEL AND DIFFERENTIAL VOLTAGE MEASUREMENTS

A second channel input option (option-03) provides a duplicate set of input amplifiers and circuits with a rear-panel connector for a second voltage probe. The 9200A can then display channel 1 or channel 2, or their instantaneous difference expressed in dB (channel 3). This option is particularly useful when measuring gain or loss.

VOLTAGE PROBES

Data for voltage probes is stored in a nonvolatile memory. This includes both sensitivity and range linearization requirements. Data for replacement probes can be entered into the nonvolatile memory by operating an internal switch that allows an alternate use of the front panel keys. No further calibration is required. Probe accessories are available for measurements on unterminated, terminated, and thru-line transmission systems of either 50 Ω or 75 Ω characteristic impedance.

DISPLAY

The 4-digit display reads either in millivolts or in dB relative to the voltage appearing across a selected power reference, such as dBm (50 Ω). The reference impedance Z_o may be entered as any value between 50 and 600 Ω. In addition, measurements can be made in terms of dBmV and dBV. An uncalibrated analog meter indicates voltage levels for peaking or nulling operations.

AUTOMATIC ZERO

A zero correction function stores the zero offsets of each range and then automatically corrects all subsequent readings. It may be activated locally or via the bus.

HIGH AND LOW DB LIMITS

High and low dB limits can be entered separately into channel 1 and channel 2. A panel annunciator and rear-panel TTL outputs indicate an out-of-limits condition.

DC DECORDER OUTPUT

A rear-panel dc output supplies 10 Volts full scale that is linear with voltage over each decade range in the mV mode, or linear in dB over the entire 80 dB range in any of the dB modes.

BUS INTERFACE

A field installable bus interface allows all instrument functions to be bus programmable, except the on-off power switch, and provides full data outputs according to bus standards.

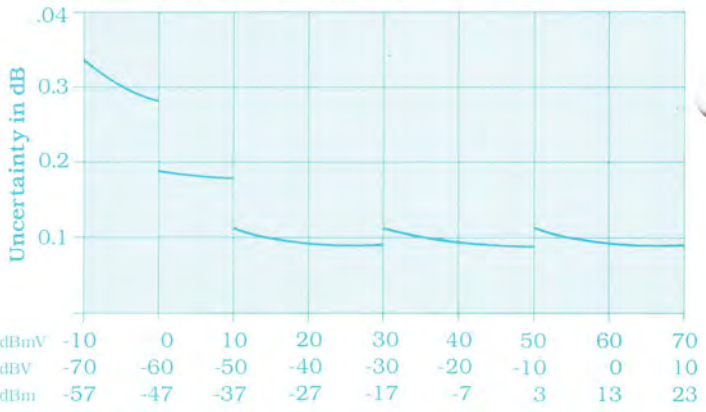
SPECIFICATIONS

Voltage Range: 200 μV to 3 V (300 V to 700 MHz with 91-7C 100:1 Divider) in 8 ranges
Voltage Display: 1.000, 3.000, 10.00, 30.00, 100.0, 300.0, 1000, and 3000 mV fs
DB Range: 80 dB in 8 ranges with 0.01 dB resolution
DB Display: dBmV (0 dB equivalent to 1 mV), dBV (0 dB equivalent to 1 V), or dBm (0 dB equivalent to the voltage across selectable Z_o reference when 1 mW is dissipated)
Z_o Reference: from 50 Ω to 600 Ω
dB Offset: selected to 0.01 dB resolution; display range ±99.99 dB
Ranging: Autoranging, plus hold-on-range. Individual ranges may be selected via bus interface option
Frequency Range: 10 kHz to 1.2 GHz (uncalibrated indications to 8 GHz)
Waveform Response: R.M.S. to 30 mV, calibrated in r.m.s. of a sinewave above 30 mV (R.M.S. to 3 V and 700 MHz with 91-7C 100:1 Divider)
Recorder output: 10 V full scale proportional to indicated voltage (mV mode) over each range, or 8 V equivalent to 0 dBm regardless of Z_o (dB mode) with a sensitivity of 1 V per 10 dB change over the entire range.

Basic Uncertainty:

Voltage Level	mV	dBV, dBmV, dBm
3mV–3000 mV	1% rdg ± 1 count	see curve
1 mV–3 mV	2% drg ± 2 counts	
0.2 mV–1 mV	3% rdg ± 3 counts	

Uncertainty vs. Input Level for dBV, dBmV, dBm



Zero: Automatic, operated by front panel key switch
dB limits: Front panel selectable dB limits, range ±99.99 dB. Front panel LIM annunciator indicates out-of-limits condition. Rear panel TTL outputs indicate high or low condition.

FURNISHED ACCESSORIES

RF Probe with low noise cable and connector	952001
50 Ω BNC Adapter; 1 kHz to 1.2 GHz	952002
Removable Probe Tip with grounding clip lead	952004

OPTIONAL ACCESSORIES

Low Frequency Probe, 1 kHz to 250 MHz	91-4C
50 Ω Sensor 200 kHz to 2.5 GHz	952009
Unterminated BNC Adapter	952008†
100:1 Voltage Divider, 50 kHz to 700 MHz	952005
Type N Tee Adapter, 1 kHz to 1.2 GHz	952003*†
Type N 50 Ω termination	952014*
Storage container for accessories	952013
Accessory Kit:	952011*
Comprises 952008, 952005, 952003, 952014, 952013	

*Available in 75 Ω versions (Reduced freq. range.)
†Available with male input

Rack Mounting Kit (Single)	950000
Rack Mounting Kit (Dual)	950001

OPTIONS:

01 IEEE 488 Bus Interface. Duplicates all front panel functions except on/off power switch. Output string gives mode, channel, data, status, and range.
03 Input Channel 2. Allows display of either Channel 1 or Channel 2, or Channel 3 which is CH1 minus CH2 expressed in dB. Includes second rf probe, 50 Ω BNC Adapter and probe tip.
04 Rear input. Duplicates front panel Channel 1 input connector.

RF Millivoltmeters
Model 92 Series

These rf millivoltmeters offer the best choice for sensitive, wideband, accurate rf voltage measurements.

Model 92B, a programmable analog version, has a large mirrored-scale meter with linear 0-3 and 0-10 voltage ranges, a dBm scale (1 mW into 50 Ω) and dc output.

Model 92B-S5, substantially same as Model 92B with mechanical strengthening to withstand greater shock and vibration, and extra humidity protection. 91-24A Probe Kit included.

Model 92BD, a programmable digital version, has 4 digit display, serial BCD data outputs, dc output. Major options are dBm display (0.01 dB resolution) and autoranging.

Model 92C, a low-cost analog version, saves by eliminating programming and dc output, by making the most sensitive range 3 mV fs, and by working to a more modest accuracy specification.

Data Bus

The Model 92BD may be adapted to the IEEE-488 Standard Data Bus by use of the Model 10A-04 Bus Interface Unit (see page 9).

SPECIFICATIONS

Analog Model 92B

Voltage Range: 200 μV to 3 V (300 V up to 700 MHz with divider). Useful indications down to 100 μV.
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 1% fs).
Indicator: 4½" taut-band meter; scales 0-3, 0-10 and dBm.
Remote Control: All functions and ranges commanded by TTL inputs.
DC Output: 10 V fs.

Digital Model 92BD

Voltage Range: 200 μV to 3 V (300 V up to 700 MHz with divider).
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 1% fs).
Display: 4 digit LED, reads 1000 fs for "10" ranges and 3000 fs for "3" ranges. Small analog meter to right of display is scaled in dBm.
Data Outputs: BCD (serial) digits, binary coded range information. Overrange, underrange, encode complete.
Remote Control: All functions and ranges commanded with TTL inputs.
DC Output: 10 V fs.

Model 92C

Voltage Range: 500 μV to 3 V (300 V up to 700 MHz with divider).
Frequency Range: 10 kHz to 1.2 GHz.
Basic Accuracy: ±(1% rdg + 2% fs).
Indicator: 4½" taut-band meter; scales, 0-3, 0-10 and dBm.

FURNISHED ACCESSORIES (all models)

RF Probe with low noise cable and connector	91-12F
50 Ω BNC Adapter: 1 kHz to 600 MHz	91-8B
Removable Probe Tip with grounding clip lead	91-13B

OPTIONS (all models)
See options list, page 23

Available Accessories (all models): 91-4C thru 91-24A/1 and 950030, 950032 (see accessories).

RF Millivoltmeter Calibrator
Model 26A

Provides full scale and incremental signal levels required for calibration of all Boonton RF Millivoltmeters.

Dynamic Range: 60μ V to 3000 mV
Full Scale Functions: 0.3, 1, 3, 10, 30, 100, 300, 1000, 3000 mV
Down Scale Increments: 20 — 100% fs, 10% fs steps
Calibration Uncertainty: < ± 0.5% rdg (at 25° C)
Harmonic Distortion: <0.15%
Temperature Influence: +0.01%/° C (0 - 50° C)
Output Frequency: 1 MHz, xtal controlled
Output Impedance: 25 Ω
Accessory Supplied: Model 91-6G male BNC open circuit probe adapter.
Available Accessories: 950030, 950032 (see accessories).

RF Microwattmeter
Model 4200

The Model 4200 is a fully automatic microprocessor-controlled instrument that measures rf power from 1 nW to 100 mW in the 200 kHz to 18 GHz frequency range. In addition to the stored-program memory, a separate non-volatile memory stores individual sensor data giving new performance features and operating conveniences in both manual and bus operation.

TWO CHANNEL AND DIFFERENTIAL POWER MEASUREMENTS

A second channel option provides an additional sensor input. This is a completely separate channel that allows concurrent power measurements in both channel 1 and 2. The Model 4200 will display power measured by channel 1 or channel 2 or their difference in dB (channel 3). This is particularly useful when measuring insertion gain or loss, or return loss.

POWER SENSORS

Seven power sensors are available for use with the Model 4200.

The 4200-4 and the 4200-5 series are full wave diode types that make extremely sensitive measurements and have a 70 dB dynamic range. The Model 4200-7E is a thin film thermocouple type that is useful for making true average power measurements of higher level pulse modulated signals. It has a 40 dB dynamic range.

Level and frequency calibration data for up to four sensors can be stored in the non-volatile memory. When the sensor number is entered, subsequent measurements are scaled and displayed for the sensor in use. By entering the measurement frequency, stored frequency calibration factors are recalled and automatically applied to the measurement. The 4200 interpolates between stored values to give a continuously smooth correction.

Data for replacement or additional sensors is entered into the non-volatile memory via an alternate function of the front panel keys activated by an internal switch.

POWER IN DB AND WATTS

The 4200 displays either 3½ digits for power measurements or 4 digits for dB (resolution 0.01 dB). The uncalibrated analog meter indicates power for easier peaking or nulling.

The dB display indicates either dBm or dBr (dB relative). In dBr any dB reference may be entered and subsequent measurements are then displayed relative to this reference.

Autoranging and hold-on-range functions are provided. In addition, a specific range may be selected via the bus.

HIGH AND LOW DB LIMITS

Separate high and low dB limits can be entered with 0.01 dB resolution. Out of limits is indicated by a panel annunciator, TTL outputs or via the bus.

DC RECORDER OUTPUT

The 4200 outputs a voltage that is linear with power over each decade range or linear with dB over the entire 70 dB instrument range.

DATA BUS INTERFACE

A field installable option adds instrument control and data output according to IEEE-488 bus standards. All functions except instrument and power reference on/off are remotely operable.

AUTOMATIC ZERO AND CALIBRATION

Automatic zero and automatic calibration functions may be activated locally or via the bus.

Auto-zero measures and stores individual range offsets and uses them to correct subsequent readings.

An NBS traceable 1 mW 50 MHz power reference is provided for automatic self calibration.

SPECIFICATIONS

Instrumentation Accuracy:

Sensor	Diode and Thermocouple	Diode	Thermocouple
Range	All Ranges Except Lowest	Lowest Range Only	Lowest Range Only
Power Accuracy	±1.2% rdg ±1 digit	±1.5% rdg ±1.5% fs	±1% rdg ±3% fs
dB Accuracy*	$\pm 0.05\ dB \pm \frac{dB_{fs} - dB_{rdg}}{200}$	$\pm 0.1\ dB \pm \frac{dB_{fs} - dB_{rdg}}{20}$	$\pm 0.1\ dB \pm \frac{dB_{fs} - dB_{rdg}}{10}$

*In channel 3 operation multiply accuracy statements x 2

Ranging: Auto, hold-on-range; individual (via bus only).
Zero: Automatic on command; drift, <10% fs of lowest range per hour.
Calibration: Automatic on command ±4% range.
Power Reference: Frequency, 50 MHz; level, 1 mW; impedance 50 Ω; Accuracy, factory set to ±0.7% traceable NBS; Stability, ±1.2% per year worst case (0 to 55°C).
Display: Power, 3½ digit; dBm or dBr, 4 digit (0.01 dB resolution.) Updated every 100 ms.
Recorder Output: Power, 0-10 V for each decade range; dBm or dBr, 9 or 8 V for entire range.
Available Sensors:

Sensor	Frequency	Power
4200-4A, 50 Ω	200 kHz — 7 GHz	-60 to +10 dBm
4200-4B, 50 Ω	200 kHz — 12.4 GHz	-60 to +10 dBm
4200-4C, 75 Ω	200 kHz — 1 GHz	-60 to +10 dBm
4200-4E, 50 Ω	200 kHz — 18 GHz	-60 to +10 dBm
4200-5B, 50 Ω	200 kHz — 12.4 GHz	-50 to +20 dBm
4200-5E, 50 Ω	200 kHz — 18 GHz	-50 to +20 dBm
4200-7E, 50 Ω	10 MHz — 18 GHz	-30 to +10 dBm

Cal Factor:
Range: ±1.25 dB called up with 0.01 dB resolution.
Adjustment: Automatic with frequency or cal-factor entry.
Uncertainty: Sum of sensor uncertainties: 1.3%, 200 kHz — 2 GHz; 3%, 2 GHz — 4 GHz increasing to 6.0% at 18 GHz (highest power range, add 0.005 dB per % fs above 4 GHz).
Accessories Furnished: 5 foot power sensor cable Model 41-2A with each sensor ordered.
Accessories Available: 950000 and 950001 Rack Mounting Kits. See pages 21, 22.

Options:
01A IEEE-488 Bus Interface. Duplicates all front-panel functions except on/off power switch and power reference switch. Output string gives mode, channel, data, status, and range.
03 Input Channel 2. Allows display of either Channel 1 or Channel 2, or Channel 3 which is Channel 1 minus Channel 2, expressed in dB. Requires use of two power sensors.
04 Rear input. Duplicates front-panel Channel 1 input connector.

RF Microwattmeter
Model 4210

Model 4210 brings to non-programmed r.f. power measurements the versatility of microprocessor technology combined with the simplicity of five-button control. Featuring ease of operation, high sensitivity, low input s.w.r., and low noise, it measures r.f. power levels from 1 nW (−60 dBm) to 100 mW (+20 dBm). The calibrated frequency range extends from 0.2 MHz to 18 GHz, depending upon the accessory sensor used; useful response for relative measurements is obtained from 20 kHz to approximately 20 GHz. Typical uses include: low-power transmitter, signal generator, and oscillator measurements; s.w.r. and return-loss measurements with directional couplers and slotted lines; gain and insertion-loss measurements; r.f. attenuation and s.w.r. measurements; and antenna measurements.

POWER SENSORS
When operated with Boonton Series 4210-4/5 sensors, the 4210 displays r.f. power by measuring the voltage across a precision, non-inductive resistor in the sensor head with specially selected diodes. Alternatively, for measuring gated or amplitude-modulated signals, thermal sensor Model 4210-7E is available. Each sensor comes marked with its appropriate calibration factor as a function of frequency. The calibration factor of the sensor being used is simply dialed into the 4210 by means of a front-panel control graduated in 0.1 dB increments.

LOW NOISE
The instrument has been designed and constructed to minimize noise from all sources. The sensor cable is of a special low-noise design; the sensors are insensitive to shock and vibration. Internal signal amplification occurs at approximately 94 Hz, thereby reducing susceptibility to 50- or 60-Hz fields. A low-noise solid-state chopper is used.

DISPLAY
Measured power levels are displayed by a 4-digit, LED-type readout with decimal points and minus sign. Annunciators associated with the LED display indicate the units of measurement. A front-panel analog meter provides relative power indications for peaking or nulling applications. The display is proportional to power on each range (PWR mode) or to dB over the entire range (dB mode).

PUSHBUTTON MEASUREMENT – MODE SELECTION
A choice of measurement modes is available to the operator. Indications in terms of power or of dBm can be selected by pressing the appropriate front-panel key switch. A dB reference level equal to the last displayed dBm value can be entered through the keyboard REF switch, and a display mode can be selected to indicate power levels in dBr relative to that dB reference level.

AUTOMATIC RANGING
Autoranging under control of the microprocesor eliminates the need for manual ranging. Applications of power levels that exceed the maximum capability of the instrument result in an error indication on the LED display.

AUTOMATIC ZEROING
An automatic zeroing circuit eliminates the need for manual zeroing. With zero input to the sensor, pressing a front-panel ZERO key switch directs the microprocessor to compute and store zero corrections for each range, and the instrument is thereafter corrected on each range in accordance with the stored data.

SIGNATURE-ANALYSIS MAINTENANCE
Connection facilities to permit signature-analysis maintenance are incorporated. Digital circuit troubles can be localized rapidly and accurately using the signature-analysis maintenance technique, thereby reducing instrument down-time.

SPECIFICATIONS

Instrumentation Accuracy: (Uncertainties include instrumentation, sensor non-linearity, range zero corrections, and noise.)

Ranges	All But Lowest (All Sensors)	Lowest (4210-4 & -5 Sensors)	Lowest (4210-7E Sensor)
PWR Mode	±1.5% rdg. ±0.1% f.s.	±2% rdg. ±1.5% f.s.	±1% rdg. ±3% f.s.
dB Modes	$\pm 0.07\ \text{dB} \pm \frac{\text{dB}_{\text{f.s.}} - \text{dB}_{\text{rdg.}}}{250}$	$\pm 0.15\ \text{dB} \pm \frac{\text{dB}_{\text{f.s.}} - \text{dB}_{\text{rdg.}}}{15}$	$\pm 0.1\ \text{dB} \pm \frac{\text{dB}_{\text{f.s.}} - \text{dB}_{\text{rdg.}}}{10}$

Ranging: Automatic

Zero: Automatic, operated by front-panel pushbutton; drift <10% f.s. of lowest range, per hour.

Display: 4-digit LED. 3½ digit display of power, 4-digit display of dB with 0.01 dB resolution. Auxiliary analog display, uncalibrated, proportional to power (PWR mode) or to dB (dB mode).

Annunciators: LED display of nW, μW, mW, dBm, and dBr.

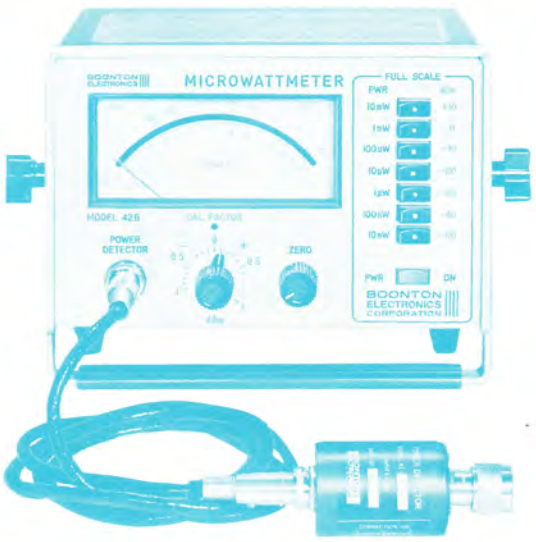
Available Sensors:

Sensor	Frequency	Power
4210-4A, 50 Ω	200 kHz – 7GHz	−60 to +10 dBm
4210-4B, 50 Ω	200 kHz – 12.4 GHz	−60 to +10 dBm
4210-4C, 75 Ω	200 kHz – 1 GHz	−60 to +10 dBm
4210-4E, 50 Ω	200 kHz – 18 GHz	−60 to +10 dBm
4210-5B, 50 Ω	200 kHz – 12.4 GHz	−50 to +20 dBm
4210-5E, 50 Ω	200 kHz – 18 GHz	−50 to +20 dBm
4210-7E, 50 Ω	10 MHz – 18 GHz	−30 to +10 dBm

Error Indication: Display shows overrange indication.

Calibration Factor: Range 1.10 dB to −1.10 dB, entered by means of front-panel control.

RF Microwattmeters
Model 42 Series



STANDARD VERSIONS

Virtually drift-free, these sensitive power meters cover a dynamic range of 70 dB from 1 nW to 10 mW (−60 to +10 dBm.) Overload tolerance is 0.3 W cw. Three 50 Ω power detectors offer a choice of frequency range. All start at a low 200 kHz covering up to as high as 18 GHz. A 75 Ω detector is available for CATV applications. The analog models are scaled in power and dBm. The digital model gives 3½ digit resolution for power and 4-digit resolution (0.01 dB) for the optional dBm display. Autoranging is also available.

HIGHER POWER VERSIONS

Specifically designed to use the higher power detector Model 41-5E these power meters cover a power range of 10 dB higher than the standard models and provide low VSWR. The dynamic range of 70 dB covers power measurements from 10 nW to 100 mW (-50 to +20 dBm.) Overload tolerance is greater than 2 W cw. All features and options of the standard models apply.

Data Bus

The Models 42BD and 42CD may be adapted to the IEEE-488 Standard Data Bus by use of the Model 10A-01 and 10A-06 Bus Interface Units (see page 9).

SPECIFICATIONS

Digital Model 42BD

Power Ranges: 10 nW fs to 10 mW fs.
Frequency Range: 200 kHz to 18 GHz.
Accuracy (Overall, instrument and detector): ±(0.2 dB + 1 digit) to ±(0.8 dB + 1 digit) depending on power range and frequency.
Stability: <1 nanowatt/hour at 25°C.
Temperature Effect: 0.007 dB/° C typ.
Indicator: 3½ digit LED display for power, 4 digit for dBm option
Data Outputs: BCD (serial) digits, binary coded range, over-range underrange, encode complete, TTL.
Remote Control: Input range, encode hold and trigger, manual disable, dBm and autorange commanded by TTL inputs.
DC Ouput: 10 V fs proportional to power.
Power Sensors: Uses 41-4 series (see accessories).

Analog Model 42B

Power Ranges: 10 nW fs to 10 mW fs.
Frequency Range: 200 kHz to 18 GHz.
Accuracy (Overall instrument and detector): ±(0.2 dB + 0.5% fs) to ±(0.8 dB + 1.0% fs) depending on power range and frequency.
Stability: <1 nanowatt/hour at 25° C
Temperature Effect: 0.007 dB/° C typ.
Indicator: 4½ inch taut band meter calibrated power and dBm.
Remote Control: Input range and manual disable commanded by TTL inputs.
DC Output: 10 V fs proportional to power.
Power Sensors: Uses 41-4 series (see accessories).

Higher Power Versions

Models: 42C Analog, 42CD Digital
Power Ranges: 100 nW fs to 100 mW fs
VSWR: <1.07 at 200 kHz, <1.28 at 18 GHz
Stability: drift <10 nW/hour at 25°C.
All other specifications are the same as the Standard Versions.
Power Sensors: Uses 41-5 series (see accessories).

Options (all models): See page 3
Available Accessories: 41-2A thru 41-5E, 950030, 950032, 960000 (see accessories).

Power Meter Calibrator
Model 25A

Provides full scale and incremental signal levels required for calibration of all Boonton Power Meters.

Dynamic Range: -69 to +20 dBm
Full Scale Functions: −60, −50, −40, −30, −10, 0, +10, +20 dBm.
Down Scale Increments: 0 to -9 dB, 1 dB steps
Calibration Uncertainty: <±0.05 dB (at 25° C)
Harmonic Distortion: <0.15%
Temperature Influence: +0.005 dB/° C (0 - 50° C)
Output Frequency: 1 MHz, crystal controlled.
Output Impedance: 50 Ω
Available Accessories: 950030, 950032 (see accessories).

IEEE-488 Bus Interface Unit
Model 10A

- Eliminates compatibility problems of couplers designed for general application.
- Works with all Boonton digital meters including most of those already in use.
- Complete with interconnecting cable and standard bus cable.

The Model 10A IEEE-488 Bus Interface Unit allows all Boonton digital meter type instruments to be adapted for use on the bus. It allows the instrument to become either a talker or listener or both under the direction of a controller such as a bus interfaceable calculator.

The stored program PROM may easily be exchanged to adapt the bus interface unit to each Boonton meter. An option number designates the PROM installed.

Interface Functions:

SH1	Source handshake capability
AH1	Acceptor handshake capability
T7	Talker (basic talker, no serial poll, talk only mode, unaddressed to talk if addressed to listen)
L3	Listener (basic listener, listen only mode, unaddressed to listen when addressed to talk)
SR0	No service request capability
RL1	Remote/Local Capability
PP0	No parallel poll capability
DC1	Device clear capability
DT1	Device trigger capability
C0	No controller capability

Model Selection:

Option	Used With:
10A-01	Model 42BD Microwattmeter
10A-02	Model 62AD 1 MHz Inductance Meter
10A-03	Model 72BD 1 MHz Capacitance Meter
10A-04	Model 92BD RF Millivoltmeter
10A-05	Model 93AD True RMS Voltmeter
10A-06	Model 42CD Microwattmeter

Available Accessories: 950033, 950034, 950035 (see accessories).

True RMS Voltmeters
Model 93 Series

The Boonton 93A and 93AD voltmeters are true r.m.s. responding instruments that use backward diodes as balanced, low-level, square-law detectors. Both cover twelve ac voltage ranges from 1 mV to 300 V full-scale. The 1 mV full-scale range provides unmatched sensitivity to measure the low r.m.s. level of noise and of low duty cycle pulse trains. Both r.m.s. voltmeters feature a full 10 Hz to 20 MHz frequency range usable down to the lowest voltage range. A 3 dB bandwidth of 30 MHz assures accurate r.m.s. measurements of complex voltages with significant high frequency energy components, such as narrow pulses and wideband noise. The 93A meter is calibrated with dBm as well as voltage scales. The 93AD has an edge-mounted dBm analog meter in addition to the digital display; an optional dB display provides readings directly in dB with 0.01 dB resolution. Autoranging is also available.

Data Bus

The Model 93AD may be adapted to the IEEE-488 Standard Data Bus by use of the Model 10A-05 Bus Interface Unit (see below).

SPECIFICATIONS

Analog Model 93A

Voltage Range: 1 mV to 300 V fs, in 12 ranges.
dBm Range: -68 dBm to+ 52 dBm (600 Ω ref.).
Selectable Bandwidth: 10 Hz to 20 MHz or 10 Hz to 100 kHz
Basic Accuracy: ±1% fs or ±2% rdg, whichever is better.
Indicator: 4½" taut-band meter; scales 0-3, 0-10 and dBm.
Response Time: Fast: 1 sec. Slow: 4 sec.
Crest Factor: 6 at full scale; 18 at down scale.
Input: *Impedance:* 2 MΩ, < 25 pF.
Equivalent noise: < 35 μV.
DC Output: + 10 V for fs.
Remote Control: All functions and ranges commanded with TTL input.
Options: See list, page 3.

Available Accessories: 950030, 950032, 960000, 93-1A (see accessories).

Digital Model 93AD

Voltage Range: 1 mV to 300 V r.m.s. fs, in 12 ranges.
dB Range: 120 dB; resolution, 0.01 dB (optional).
Selectable Bandwidth: 10 Hz to 20 MHz or 10Hz to 100 kHz
Basic Accuracy: ±(1% rdg + 1 count) for voltage.
±0.2 dB for dB option.
Display: 3½ digit LED display (4 digits for dBm). Decimal point, units (V, mV, dB), under- and over-range, polarity (dBm only) also indicated. Analog edgemeter, scaled over 12 dB range.
Response Time: Fast: 1 sec. Slow: 4 sec.
Crest Factor: 6 at full scale; 18 at down scale.
Input: *Impedance:* 1 MΩ, < 25 pF.
Equivalent noise: < 35 μV.
Outputs: BCD (serial) digits, binary range and mode information.
DC Output: 10 V for fs.
Remote Control: All functions and ranges commanded with TTL input.
Options: See list, page 3.

Available Accessories: 950030, 950032, 960000, 93-1A, 93-2A (see accessories).

FM/AM Modulation Meter 10 MHz to 1.3 GHz
Model 82AD

The Model 82AD FM and AM Modulation Meter combines automatic tuning and leveling with very high accuracy. In addition, it offers the advantages of digital display and an optional IEEE-488 bus interface.

AUTOMATIC OPERATION
In operation, the highest amplitude RF carrier in the frequency range from 10 MHz to 1.3 GHz is automatically acquired and normalized in level to produce a 1 MHz IF replica of the RF modulated carrier. After demodulation the recovered audio is filtered, measured and digitally displayed in terms of modulation depth or carrier deviation.

DETECTORS
Keys select display of positive or negative peak modulation or peak average, each in three ranges for both FM and AM. Detection is true peak at all levels with low distortion.

AUDIO FILTERS
Four high pass and four low pass filters plus four de-emphasis networks provide the means for bandpass simulation of most communication systems. The 6 dB/octave position relates phase deviation to the frequency deviation displayed.

ACCURACY AND RESOLUTION
The 4-digit display of the Model 82AD provides excellent accuracy and resolution. FM accuracy is 2% of reading at rates from 30 Hz to 100 kHz. AM accuracy is 2% of reading from 10% to 90% AM, and 5% of reading below 10% and above 90%; rates from 30 Hz to 100 kHz. Resolution for either FM or AM is 0.1% of full scale.

The AM calibration of each 82AD provides the especially accurate readings needed to test ILS transmitters to FAA requirements.

BUS INTERFACE
The field-installable, plug-in IEEE-488 bus interface option provides completely interactive programming by either the bus controller or the 82AD panel controls. Lighted annunciators display all range and status information.

SPECIFICATIONS

RF INPUT
Frequency Range: 10 MHz — 1.3 GHz
Sensitivity: 10 mV r.m.s., 10 MHz–520 MHz
30 mV r.m.s., 520 MHz – 1.3 GHz
Tuning Acquisition Time: 100 ms at 100 MHz typical
Level Acquisition Time: 2 s typical

FREQUENCY MODULATION
Deviation Ranges: 10, 100, 300 kHz fs peak
Deviation Accuracy: ± 2% of reading ±1 digit
Rates: 30 Hz to 100 kHz
Residual FM: <15 Hz r.m.s. at 100 MHz (30 Hz to 15 kHz BW)
AM Rejection: <100 Hz deviation at 50% AM (1 kHz rate)
Stereo Separation: >46 dB; 200 Hz – 15 kHz BW, (to 50 Hz with external LO)
Distortion: <0.1% THD for ±100 kHz dev.

AMPLITUDE MODULATION
Depth Ranges: 10%, 100% fs
Accuracy: ±2% of reading ±1 digit, 10% to 90% AM
±5% of reading below 10% and above 90% AM
Rates: 30 Hz to 100 kHz
Residual AM: <0.05% AM r.m.s. for inut levels above 100 mV r.m.s. (RF <520 MHz, 30 Hz – 15 kHz BW)
FM Rejection: <0.5% AM at ±50 kHz deviation (<100 kHz rate)
Distortion: <0.2% THD for 30% AM

AVIONICS:
Depth Accuracy: ±0.7% of reading at 20, 30, and 40% AM, f mod. 30 Hz — 3 kHz (Filter, 10 Hz — 15 kHz)
Detector Flatness: Indicated AM for constant % AM between 20 and 40% and f mod. of 90 and 150 Hz will be within ±0.4%

AUDIO FREQUENCY RESPONSE

Filters:	*High Pass*	*Low Pass*	*De-emphasis*
	<10 Hz	3 kHz	50 μS
	30 Hz	15 kHz	75 μS
	300 Hz	120 kHz	750 μS
	3 kHz	200 kHz	6 dB/Oct (ref. 1 kHz)

Shape Factor: All filters are three-pole Butterworth except 10 Hz and 200 kHz. De-emphasis time constant and 3 dB filter frequencies have an accuracy of ±4% (except 10 Hz).

DISPLAY
Modulation: 4 digit LED display; 1000 counts + 100% overrange; + peak, — peak, or peak average indication.
Annunciators: All panel functions plus level, lock, overrange, remote.

OUTPUTS
Audio: 1 V/600 Ω at 1000 counts
IF: 1 MHz, 0 dBm 50 Ω
DC: 1 V, 1000 counts, 1000 Ω source

OPTIONS
See list, page 3.

AVAILABLE ACCESSORIES
82-1A, 82-2A (see accessories).

FM/AM Modulation Meter 2 MHz to 1.5 GHz
Model 8210

The Model 8210 is a versatile, microprocessor-based instrument designed for laboratory and field applications. Among its outstanding features are: low cost, automatic operation, self-calibration, digital display, and low residual modulation and noise.

To create modulation standards, the 8210 automatically generates two crystal-controlled frequencies to calibrate the f.m. channel, and two levels—differing by a precise amount—to calibrate the a.m. channel. The results are verified mid-range accuracies of 1% of reading for both a.m. and f.m. measurements, without the need for expensive external calibration set-ups.

AUTOMATIC TUNING AND LEVELING

The 8210 will automatically seek and lock to the strongest carrier in a continuous frequency range from 2 MHz to 1.5 GHz. It then adjusts its gain to produce a standardized 400 kHz replica of the modulated signal. This i.f. signal is processed by true peak-responding detectors, and the results are presented to read in terms of plus-peak, minus-peak, or peak-averaged f.m. deviation; or it can read in peak-crest, peak-trough, or peak-averaged % a.m.

INTERNAL CALIBRATION

The 8210 calibrates its a.m. and f.m. detectors each time line power is applied.

PUSHBUTTON OPERATION

All operational parameters of the instrument are selected by pushbuttons—providing for fast measurement set-up.

DIGITAL DISPLAY

Recovered modulation is presented on a 3½ digit LED display, which provides full-scale resolution of 0.1% for both a.m. and f.m. measurements, with 50% overrange. Plus or minus signs indicate whether the plus-peak or minus-peak has been selected; absence of a sign denotes a peak-averaged display.

AUDIO FILTERS

Two low-pass filters and a de-emphasis filter are switch-selectable. By the change of one jumper connection, the de-emphasis network can be inserted either before the display, or following the display but before the demodulated output.

LOW RESIDUAL MODULATION

The exceptionally low residual modulation of the 8210 permits accurate measurements of low-noise sources. Direct residual measurements are possible if an external r.m.s. detector is used.

OPTION

See list, page 3.

AVAILABLE ACCESSORY

954005 (see accessories).

US $2340

SPECIFICATIONS

RF INPUT

Carrier Frequency Range: 2 MHz to 1.5 GHz

Tuning: Automatic

Sensitivity: 10 mV r.m.s., 2 MHz to 520 MHz
30 mV r.m.s., 520 MHz to 1.5 GHz.

Level set: Automatic for levels up to 1 volt.

Maximum safe input: 4 V r.m.s.

Input impedance: 50 ohms, nominal

FREQUENCY MODULATION

Deviation: 10 and 100 kHz, full-scale.

Deviation Accuracy: 1% of reading for modulation frequencies between 50 Hz and 5 kHz.
NOTE: Peak residuals must be accounted for to obtain above accuracy.

Modulation Frequency Range: 30 Hz to 15 kHz.

Residual F.M.: Less than 150 Hz r.m.s. at 1.5 GHz decreasing linearly to a floor of less than 5 Hz r.m.s., with 3 kHz low-pass filter. Less than 200 Hz r.m.s. at 1.5 GHz decreasing linearly to a floor of less than 7.5 Hz r.m.s. with 15 kHz low-pass filter.

A.M. Rejection: Less than 100 Hz deviation at 50% A.M. (F mod. 1 kHz or less), 3 kHz low-pass filter.

AMPLITUDE MODULATION

Modulation Depth Ranges: 10% and 100%, full-scale.

Depth Accuracy: 1% of reading, 10 to 90% A.M. 3% of reading, below 10 and above 90% A.M. for modulation frequencies between 50 Hz and 5 kHz.
NOTE: Peak residuals must be accounted for to obtain above accuracy. Carrier frequency <520 MHz. R.F. level between −10 and +10 dBm.

Modulation Frequency Range: 30 Hz to 15 kHz.

Residual A.M.: Less than 0.25% A.M. r.m.s. for input levels above 100 mV r.m.s., 15 kHz low-pass filter. Less than 0.15% A.M. r.m.s. for input levels above 100 mV r.m.s., 3 kHz low-pass filter. Carrier frequency less than 520 MHz. Above 520 MHz, residuals increase linearly with frequency.

F.M. Rejection: Less than 1.0% A.M. peak at 100 kHz peak modulation.

AUDIO FREQUENCY RESPONSE

Filters: 3 kHz low-pass, 15 kHz low-pass, and 750 μs de-emphasis. De-emphasis can be either before or after the display (jumper selected.)

Audio Distortion: Less than 0.25% t.h.d. for 75 kHz peak deviation. Less than 0.5% t.h.d. for 90% A.M.

Output Level: 1 V r.m.s. nominal into 600 ohms at 1000 counts on display for F.M., 1 to 1.2 V r.m.s. for A.M.

DISPLAY

Modulation: LED display; 1000 counts +50% overrange; true peak, + peak, − peak, or peak average indication.

Annunciators: Display of filter and mode switch settings. Digital display indicates level high, level low and unlock conditions.

I.F. OUTPUT

Frequency: 400 kHz, nominal.

Level: 300 to 360 mV nominal into 600-ohm load.

Programmable FM/AM/ΦM Signal Generators
Models 1020 (150 kHz–540 MHz) and 1021 (150 kHz–1.08 GHz)

The Models 1020 and 1021 FM/AM/ΦM Signal Generators answer the need for a fully programmable spectrally pure source of RF power at a precise level with low distortion and wide-band modulation for fast and automatic testing of receivers, amplifiers, filters, mixers, and other components.

SPECIAL FEATURES

- High RF output level of + 19 dBm to 540 MHz and + 16 dBm to 1.08 GHz
- RF output level programmable in 0.1 dB steps
- Selectable 50 or 75 ohm reference for output voltage indication
- Preset or user defined frequency step size
- Repetitive step key or digital knob tuning
- Free format for number input, fixed or floating
- Very low distortion FM, 0.05% at 75 kHz deviation over the FM band
- True phase modulation
- Low distortion AM
- Very low distortion, variable-frequency modulation oscillator, 20 Hz – 50 kHz
- Programmable modulation oscillator output level
- Recall of up to 250 complete instrument set-ups from non-volatile memory
- Single key stroke recall of consecutive set-ups
- Analog sweep with intensity marker
- Digital sweep with start/stop frequencies
- Return of function arguments via interface bus
- Built-in test routines
- Detailed error identification by number

MODULATION

The generators provide completely independent and versatile capabilities for AM, FM, and ΦM. Frequency modulation may be set to a peak deviation of 600 kHz with 10 Hz resolution up to 30 kHz deviation, 100 Hz resolution up to 300 kHz deviation, and 150 Hz resolution up to 600 kHz deviation. FM bandwidth (3 dB) is from less than 5 Hz to 200 kHz and the flat band extends from 50 Hz to 100 kHz. This deviation and bandwidth capability coupled with low distortion and good stereo separation makes the 1020 and 1021 outstanding, and among the few generators able to satisfy the needs of broadcast receiver measurement. Amplitude modulation depth can be set from 0 to 99.9% in 0.1% steps. AM bandwidth (1 dB) is dc to 50 kHz for carriers above 2 MHz and dc to 20 kHz for carriers below 2 MHz. Distortion is low even at high percentage AM, and group delay in the AM channel has been controlled so that a bearing error of no more than 0.1° is contributed by the generator in VOR receiver tests.

MODULATION OSCILLATOR

The modulation oscillator covers frequencies from 20 Hz to 50 kHz and is a very low distortion source that can drive any of the modulation channels to produce a low-distortion modulated carrier. Its output is also available externally, and this can be programmed to provide any level between 0 and 4 V, with 1 mV resolution independent of the selected modulation.

FREQUENCY SWEEP: (ANALOG/DIGITAL)

RF response, IF response, and image rejection testing on AM/FM receivers is greatly simplified by the high/low speed sweep functions of the 1020 and 1021. Three sweep widths are provided. Narrow and medium sweeps can be centered at any carrier frequency over the complete frequency range of the generator. The wide sweep splits the entire range of the generator into frequency segments. The marker is of the intensified type, and its frequency (which is the center frequency for narrow and medium sweeps), is set using the carrier-frequency entry and control functions. The sweep rates are 60 Hz for narrow and medium sweeps, and 40 Hz for the wide sweep – thus providing a clear, flicker-free trace on any oscilloscope. Digital sweep allows the 1020/21 to automatically increment fc from selected start to stop frequencies in specified steps. Swept output is from the RF output connector at the same levels as normal operation; X axis ramp voltage, and marker and retrace gate pulses are also provided.

PROGRAM STORE AND RECALL

The 1020 and 1021 have the ability to store and recall up to 250 complete front panel set-ups from a non-volatile memory. This feature is standard and not an extra-cost option.

IEEE-488 GPIB

An IEEE-488 interface is a standard feature of the generators. It allows their full potential to be realized for fast sophisticated measurements within a test system.

SPECIFICATIONS

FREQUENCY

Range: 150.000 kHz – 539.9998 MHz
150.000 kHz – 1.0799995 GHz (Model 1021)

Resolution: 50 Hz 0.15 – 135 MHz
100 Hz 135 – 270 MHz
200 Hz (250 Hz, Model 1021) 270 – 540 MHz
500 Hz 540 – 1080 MHz (Model 1021)

REFERENCE OSCILLATOR

Frequency: 10 MHz, oven stabilized, or external input
Aging Rate: $< \pm 1 \times 10^{-8}$/24h

SPECTRAL PURITY

(at +13 dBm and below)
Harmonics: –30 dBc, 1 MHz–1080 MHz, –25 dBc below 1 MHz
Non-Harmonic Spurious: –50 dBc, 0.15 – 33.75 MHz
–70 dBc, 33.75 – 540 MHz
–50 dBc, 540 – 1080 MHz
Sub Harmonics: –50 dBc, 270 – 540 MHz
–30 dBc, 540 – 1080 MHz (Model 1021)
Noise Floor: –140 dBc (–143 dBc, typical)

RESIDUAL FM AND SSB TOTAL NOISE (INCLUDES PHASE AND AMPLITUDE NOISE), TYPICAL

Frequency	Residual FM	SSB Total Noise
MHz	0.3–3kHzBW	1HzBW, 20kHz offset
0.15–33.75	<5 Hz	–130 dBc
33.75–67.5	<5 Hz	–132 dBc
67.5–135	<5 Hz	–130 dBc
135–270	<7 Hz	–126 dBc
270–540	<10 Hz	–122 dBc
540–1080*	<25 Hz	–117 dBc

* Model 1021

Residual AM: <0.005% r.m.s., –86 dBc; 30 Hz –3 kHz BW

OUTPUT

Range: –146.9 dBm to +19 dBm (+13 dBm with AM) to 540 MHz
–146.9 dBm to +16 dBm (+10 dBm with AM) to 1080 MHz (Model 1021)

Resolution: 0.1 dB or 1.16% of the voltage

Accuracy: ±2.5 dB worst case to 540 MHz
±3.5 dB worst case to 1080 MHz (Model 1021)

Flatness: ±0.75 dB maximum variation at ≤0 dBm to 540 MHz
±1.5 dB maximum variation at ≤0 dBm to 1080 MHz (Model 1021)

Impedance: 50 Ω

SWR: <1.5 for levels ≤0 dBm

RF Interrupt: >60 dB isolation in "off" mode

Reverse-Power Protection: up to 50 W. Externally replaceable fuse in output connector

RF Leakage: <1μV at 1 inch from any surface measured with a 1-inch diameter, 2-turn loop into a 50-ohm receiver

FREQUENCY MODULATION

Deviation: 0–600 kHz peak for carriers ≥ 725 kHz
0–(fc – 125)kHz peak for carriers < 750 kHz

Resolution: 10 Hz for 0–30 kHz Peak Dev. 100 Hz for 30–300 kHz Peak Dev. 150 Hz for 300–600 kHz Peak Dev.

Deviation Accuracy: at 1 kHz rate
0–300 kHz ± (5% of setting + 100 Hz)
300–600 kHz ± (5% of setting), except 33.75–67.5 MHz
300–500 kHz ± (7% of setting), 33.75–67.5 MHz only

Distortion (THD at 1 kHz mod rate):

Carrier Frequency	Max. Dev.	THD	THD
0.15–33.75 MHz	600 kHz or fc–125 kHz	<0.1% at fc–125 kHz or 100 kHz dev.	≤1% of 500 kHz if fc >625 kHz
33.75–67.5 MHz	600 kHz	<0.1% at 50 kHz dev.	<5% at 500 kHz
67.5–135 MHz		**<0.1% at 100 kHz dev.	<1% at 500 kHz
135–270 MHz		<0.1% at 200 kHz dev.	<0.5% at 500 kHz
270–540 MHz			
540–1080 MHz*			

**0.05% at 75 kHz. dev. over F.M. range 76–108 MHz *Model 1021

Bandwidth: 5 Hz–200 kHz, < 3 dB down
DC–200 kHz < 3 dB down, unlocked mode

Flatness: ± 1 dB, 50 Hz–100 kHz
± 1 dB, dc – 100 kHz, unlocked mode

Stereo Separation: > 45 dB (50 Hz–15 kHz BW)

PHASE MODULATION

Deviation: 0–6.00 radians, peak

Resolution: 0.01 radian

Deviation Accuracy: ± (5% of setting + 0.01 radian), 1 kHz rate

Bandwidth: 50 Hz–15 kHz, ± 1 dB

AMPLITUDE MODULATION

Depth: 0–99.9%

Resolution: 0.1% AM

Depth Accuracy: (measured at 1 kHz rate)
± (5% of setting + 1% AM), 150 kHz–540 MHz
± (6% of setting + 1% AM), 540 MHz–1080 MHz

Bandwidth: dc to 50 kHz (<1 dB down), fc >2 MHz
dc to 20 kHz (<1 dB down), fc <2 MHz

VOR Bearing Error: <0.1°, 108–118 MHz

Peak Incidental ΦM with AM: <0.2 radians at 30% AM

Peak Incidental FM with AM: Incidental ΦM x modulation rate

Distortion: (measured at 1 kHz mod. rate)

AM Depth	Total Harmonic Distortion	
	150 kHz–540 MHz	540 MHz–1080 MHz
30%	1%	2%
70%	2%	4%
90%	3%	6%

FREQUENCY SWEEP

ANALOG SWEEP WIDTHS, FIXED

Carrier Frequency Range	Sweep 3 Narrow	Sweep 2 Medium	Sweep 1 Wide
0.15–33.75 MHz	± 600 kHz	± 1.2 MHz	Approx. 10 MHz
33.75–67.5 MHz	± 300 kHz	± 600 kHz	Approx. 10% of fc
67.5–135 MHz	± 600 kHz	± 1.2 MHz	Approx. 10% of fc
135–270 MHz	± 1.2 MHz	± 2.4 MHz	Approx. 10% of fc
270–540 MHz	± 2.4 MHz	± 4.8 MHz	Approx. 10% of fc
540–1080 MHz*	± 4.8 MHz	± 9.6 MHz	Approx. 10% of fc

*Model 1021

ANALOG SWEEP WIDTH, VARIABLE:
The sweep width of SWP 2 or SWP 3 can be controlled by the setting of 0–600 kHz FM deviation of the internal FM function.

Repetition Rate:

Sweep	Frequency			
1	65 Hz	40 Hz	8 Hz	2 Hz
2 & 3	61 Hz	27 Hz	10 Hz	1 Hz

DIGITAL SWEEP
Allows the 1020/21 to automatically increment fc from selected start to stop frequencies in specified steps. Time/Step may be selected from one of the four preset values 110, 250, 500, and 800 ms. At the same time a scaled voltage ramp of fixed amplitude is provided for use with an X-Y plotter.

MODULATION SOURCE

Frequency Range: 20.00 Hz–50.00 kHz

Frequency Accuracy: ± 1% of setting, 20 Hz–10 kHz
± 2% of setting, 10 kHz–50 kHz

Frequency Resolution: 1 Hz, 20 Hz–249 Hz
10 Hz, 250 Hz–2490 Hz
100 Hz, 2.5 kHz–24.9 kHz
200 Hz, 24.9 kHz–50.0 kHz

Output Level:

Range: 0–4.095 V r.m.s., output impedance 600 Ω

Accuracy: ± (0.5% of setting + 1 mV), 10 mV to 4 V

Resolution: 1 mV

Distortion: (THD for Vout = 1 V r.m.s.)

External	Internal
20 Hz–249 Hz < 0.25%	20 Hz–249 Hz < 0.25%
250 Hz–10.0 kHz < 0.05%	250 Hz–390 Hz < 0.05%
10 kHz–50.0 kHz < 0.15%	400 Hz–25.0 kHz < 0.02%
	25 kHz–50.0 kHz < 0.05%

GPIB OPERATION

IEEE-488 Functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1

Typical Programming Switching Time
From Start of Frequency Change (carrier > 33.75 MHz)

Conditions	Time
Frequency within ± 3 x 10^{-5} of new value	60 ms
Frequency within ± 1 x 10^{-5} of new value	110 ms
Frequency within ± 5 x 10^{-7} of new value	<1s

For small frequency steps (≤ 10 kHz) with controller in send mode and 1020/21 in step frequency mode:

	Step/s	Time/Step
Display On	12.5	80 ms
Display Off	20	50 ms

OPTIONS
See list, page 3.

AVAILABLE ACCESSORIES
954006, 954011, 950009, 950010, 950024 (see accessories).

FM-AM Signal Generators 450 kHz to 1040 MHz
Models 102E and 102F

The 102E/F Signal Generators combine high performance with reasonable price. The 102F model has phase lock, the 102E does not, otherwise they are essentially identical.

Important features:

- Optional frequency coverage to 1040 MHz
- Low distortion, wide bandwidth FM
- Wide FM deviation on all RF bands
- Low phase shift AM optimized for VOR tests
- Low sideband noise and residual FM
- External counter capability to 150 MHz
- Optional variable-frequency modulation oscillator
- 10 Hz RF resolution for narrow-band receiver testing
- Externally replaceable RF fuse for reverse power protection

FREQUENCY AND COUNTER DISPLAY

The six-digit display gives selectable 10 Hz, 100 Hz, or 1 kHz resolution at all output frequencies. External frequencies are counted over a frequency range of 5 Hz to 150 MHz with up to 1 Hz resolution, which often eliminates the need for a separate counter.

PHASE LOCK (102F)

When the lock button is pressed, the 102F output frequency is locked to a separate internal VCXO for 0.05 ppm/hour stability. Full FM capability is maintained down to 50 Hz modulation rates. The frequency display indicates true output frequency, even when fine-tuning between lock points.

SPECTRAL PURITY

Noise performance closely approaches that of state-of-the-art generators costing half as much again as the Model 102F. A contributor to this performance is the inductively tuned master oscillator which uses a low-noise transistor in a special noise reducing circuit.

AMPLITUDE & FREQUENCY MODULATION

Metered deviation of up to ±300 kHz peak is available on all RF ranges. Unmonitored ±1 MHz deviation is possible with external drives, and even up to ±2 MHz on the highest frequency band. Low 0.05% THD is available at 75 kHz deviation in the FM broadcast band.

AM channel bandwidth is extremely wide with phase shift optimized to 0.1° for VOR tests.

PULSE MODULATION

Option −24 adds pulse modulation from 5 MHz to 1040 MHz. TTL inputs give rise and fall times < 0.5 μs, minimum pulse duration 1 μs and repetition rates dc to 500 kHz.

SPECIFICATIONS (102F)

FREQUENCY

Range: 450 kHz to 520 MHz (to 1040 MHz, option −20)
Accuracy: ±(resolution + 1 ppm), 15°C to 35°C
Resolution: Selectable: 10 Hz, 100 Hz, 1 kHz
Stability: *Phase locked*
32-1040 MHz, <0.2 ppm/hr after 1 hour
<0.05 ppm/hr after 4 hours
0.45-32 MHz, <100 Hz/hr after 1 hour
Unlocked
32-1040 MHz, 10 ppm/10 min. after 2 hours
0.45-32 MHz, <1.5 kHz/10 min. after 1 hour

RF OUTPUT

Power Level: −130 dBm to +13 dBm (0.07 μV to 1 V)
Attenuator: 13 steps, 10 dB ±0.25 dB/step plus variable 13 dB calibrated on output meter
Accuracy: Cumulative (worst case) ±2.0 dB to 260 MHz, ±3.0 dB at 1040 MHz
Leveling: ±0.5 dB max. variation across each band to 260 MHz, ±0.75 dB to 520 MHz, ±1.0 dB to 1040 MHz
Impedance: 50 ohms, VSWR <1.5:1 at levels below 0 dBm
Leakage: <1 μV; 1" dia. 2 turn loop, 1" from surface 50 Ω receiver

SPECTRAL PURITY *(at +10 dBm and below)*

SSB Total Noise: (at 20 kHz offset from carrier in 1 Hz bandwidth).
(Total noise includes both phase and amplitude noise)
450 kHz – 130 MHz, −138 dBc
130 – 260 MHz, −135 dBc
260 – 520 MHz, −130 dBc
520 – 1040 MHz, −124 dBc
Residual FM: (0.3 to 3.0 kHz BW) <7 Hz to 130 MHz, <10 Hz to 520 MHz, <20 Hz to 1040 MHz
Harmonics: 25 to 30 dBc
Sub Harmonics: 30 to 40 dBc
Mixing Products: 30 dBc

FREQUENCY MODULATION

Ranges: 3 kHz, 10 kHz, 30 kHz, 100 kHz, 300 kHz, peak fs
Accuracy: ±7% fs, 20 Hz to 200 kHz
Bandwidth (unlocked): DC to 200 kHz
Bandwidth (locked): 50 Hz to 200 kHz
Distortion: For 100 kHz dev., THD is 1.0% at 450 kHz, 0.15% at 520 MHz and 0.1% at 1040 MHz. (−19 option: for 75 kHz dev., THD is 0.05% 76-108 MHz.)
Stereo Channel Separation: >50 dB, 50 Hz to 15 kHz rates

AMPLITUDE MODULATION *(at +10 dBm and below)*

Ranges: 30%, 100% fs
Accuracy: *450 kHz to 520 MHz:* ±(1% AM + 6% rdg) to 90% AM
520 MHz to 1000 MHz: ±(1% AM + 8% rdg) to 70% AM
Bandwidth: DC to 25 kHz (3.0 dB BW 50 kHz)
Distortion: (0.4 to 1.0 kHz rates)

Below 520 MHz	*Above 520 MHz*
<1% THD at 30% AM	<2% THD at 30% AM
<3% THD at 80% AM	<5% THD at 70% AM

VOR Bearing Error: <0.1°, 108 — 118 MHz (opt. 21)

INTERNAL MODULATION OSCILLATOR

Standard on 102E
Frequencies: 400 Hz, 1 kHz, 3 kHz, 10 kHz, 19 kHz
Distortion: < 0.15% THD
Standard on 102F, option −12A on 102E
Variable Frequencies: 20 Hz to 20 kHz in three decade ranges
Fixed Frequencies: 400 Hz, 1 kHz
Distortion: < 0.05% THD above 100 Hz, variable; < 0.03% THD, fixed

FREQUENCY COUNTER

Input: 5 Hz to 150 Hz, 100 mV into 1 MΩ/90 pF
Display: 6 digits with max. resol. of 1 Hz to 20 MHz, 10 Hz, to 150 MHz
Accuracy: ± (resolution + 1 ppm) 15°C to 35°C

OPTIONS

See list, page 3

AVAILABLE ACCESSORIES

102-3A, 960000 (see accessories)

FM/AM Signal Generators 125 kHz to 175 MHz
Models 103C and 103D

NOTE: For those involved in A.M. Stereo design or testing, Boonton Electronics offers the Model 103D-S3, an F.M.-A.M. Signal Generator featuring sweep capability, phase lock, and special optimization for the Magnavox and similar A.M. Stereo systems. Also available is the Model 1101, A.M. Stereo Modulator.

The 103C/D Signal Generators cover applications in design, production and maintenance of receivers and systems in the entertainment and communications fields.

They have these important advantages:

- High resolution and accuracy provided by the digital frequency display.
- Phase-lock stability referenced to internal TCXO (103D).
- High quality, versatile FM and AM, peak monitored on separate meter.
- Wide output range -130 dBm to + 23 dBm (3 V).
- Five sweep ranges with digital readout of sweep center-frequency and the frequency of a variable intensity marker on the 10.7 MHz and 98 MHz ranges.
- External count capability to the full accuracy and resolution of the frequency display.

FREQUENCY

The six-digit LED display has selectable resolutions down to 1 Hz below 16 MHz RF (10 Hz resolution above 16 MHz). The zero backlash, adjustable-friction controls give velvet smooth tuning to take full advantage of this resolution. Unusually good unlocked stability minimizes the need to retune.

PHASE-LOCK (103D only)

The 103D output frequency may be phase locked to an internal reference temperature compensated crystal oscillator. To lock the generator, the desired frequency is set and a lock button depressed. Fine tuning is accomplished by a "lock vernier" control. An important feature is that the true frequency is displayed at all times even when tuning between lock points with the "lock vernier". This is because the lock reference and display time base reference are separate oscillators.

MODULATION

Five internal sinewave modulation frequencies, external, and a line frequency ramp for sweep operation are standard. Other frequencies in the range of 20 Hz to 100 kHz may be optionally provided.

FM deviation is up to 100 kHz from 8 to 32 MHz, and 300 kHz above 32 MHz. Unlocked bandwidth is dc to 200 kHz.

Full-scale AM ranges of 30% and 100% are provided. Bandwidth is dc to 20 kHz above 1 MHz. Meter is true peak indicating for both FM & AM.

FREQUENCY SWEEP

There are five sweep ranges. The 10.7 MHz and 98 MHz center frequency sweeps are provided with a variable frequency intensity marker. Both the sweep center frequency and marker frequency may be read off the counter display. Sweep width is adjustable and read on the modulation meter. Sweep output is via the RF output connector, and it is monitored, leveled and adjusted in the same way as the normal RF output of the generator.

RF AND SWEEP OUTPUT

The output level is switched in 13 steps of 10 dB. Settings between these steps are made using the variable control and are read on the output meter.

The RF output can be switched off by a front panel slide switch. This same switch can also be used to obtain a special high level metered output to +23 dBm (3 V into 50 Ω). Total range is −130 dBm to +23 dBm.

SPECIFICATIONS

FREQUENCY

RF Range: 125 kHz to 175 MHz in 11 bands.
Resolution: Selectable: 1 Hz (<16 MHz RF), 10 Hz, 100 Hz, 1 kHz
Accuracy: ± (resolution + 1 ppm) 15 — 35°C
Stability: 10 ppm/10 min. after 2 hr. In phase-locked mode <0.05 ppm/hr. after 4 hrs., 0.2 ppm/hr. after 1 hr. (103D only)

FREQUENCY SWEEP

Ranges:

f_o	*Max. sweep width*
262 kHz	±30 kHz
455 kHz	±30 kHz
1.2 MHz	±100 kHz
10.7 MHz	±1 MHz*
98 MHz	±10 MHz*

**Ranges with intensity marker*

Drive: *Internal:* 50-60 Hz ramp (line synchronized)
External: 10 Hz to 1 kHz rates
Marker Pulse: +4V, 60 μS

EXTERNAL COUNTER

Frequency Range: 5 Hz to 175 MHz
Resolution: 1 Hz below 16 MHz, 10 Hz above
Reference Accuracy: < ±1 ppm, 15°C to 35°C

FREQUENCY MODULATION

Max. Deviation: Bands 9-11 (32-175 MHz), ±300 kHz peak
Bands 7-8 (8-32 MHz), ±100 kHz peak
Ranges: 3, 10, 30, 100, 300 kHz
Accuracy: ±7% fs
Bandwidth: Unlocked, DC to 200 kHz
Locked, 50 Hz to 200 kHz (103D only)
Distortion:

Band	*THD at 100 kHz Dev.*	*THD at 75 kHz Dev.*
8-16 MHz	2.0%	
16-32 MHz	1.0	
32-64 MHz	0.5	
64-138 MHz	0.3	0.2% 76-108 MHz*
138-175 MHz	0.5	

**0.05% opt. 19*

Stereo Channel Separation: >46 dB (50 Hz to 15 kHz rates)

AMPLITUDE MODULATION

Ranges: 30% AM, 100% AM fs
Accuracy: ±(1% AM +7% rdg.) to 80% AM at 1 kHz rate
Bandwidth: DC to 20 kHz (1 to 175 MHz)
DC to 10 kHz (250 kHz to 1 MHz)
DC to 5 kHz (125 to 250 kHz)
Distortion: <1% THD at 30% AM, 1 kHz rate

INTERNAL MODULATION OSCILLATOR

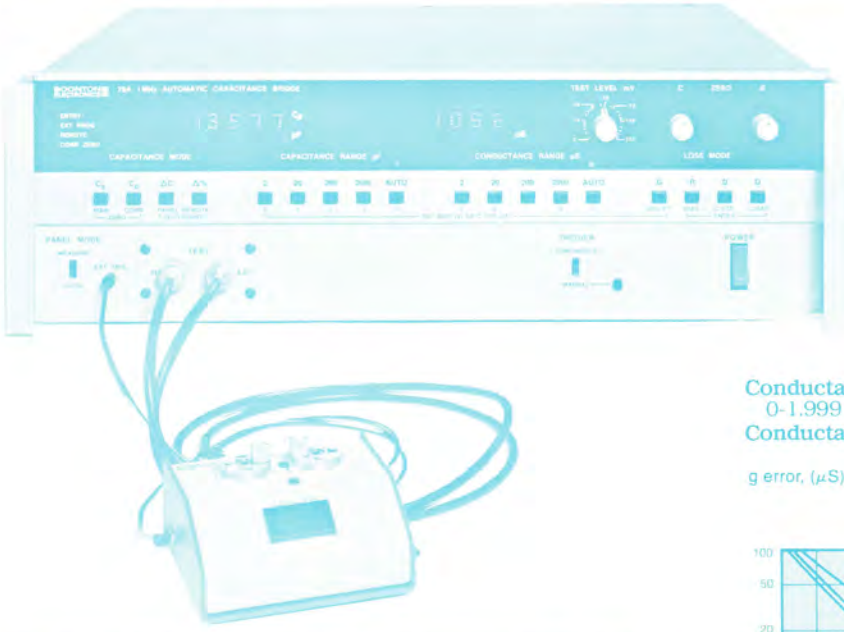
Frequencies: *Sine:* 400 Hz, 1 kHz, 3 kHz, 10 kHz, and 19 kHz
Ramp 50 -60 Hz (line synchronized)
Sinewave distortion: <0.2% THD

RF AND SWEEP OUTPUT

Level (normal): -130 dBm to + 13 dBm (0.07 μV to 1 V into 50 Ω)
Level (high): To + 23 dBm (3V) all bands (Restricted AM above + 20 dBm)
Attenuator: 13 steps of 10 dB/step + variable 13 dB calibrated on output meter
Accuracy: Step to step ±0.25 dB, cumulative ±2.0 dB (worst case)
Leveling: ±0.5 dB max. variation across each band
Impedance: 50 Ω, VSWR <1.3 below 0 dBm
RF Interrupt: >50 dB isolation (at 0 dB on output meter)
SSB Total Noise: 125 dB below carrier at 20 kHz offset (1 Hz bandwidth)

Options: See list, page 3.
Available Accessories: 102-3A, 960000, 954006 (see accessories).

Automatic 1 MHz Capacitance Bridge
Model 76A



The Model 76A combines established precision bridge techniques with an automatic balancing system and internal computing facilities. It makes fully automatic, triggered or free running, 1 MHz parallel capacitance and conductance measurements with test levels of from 5 to 200 mV r.m.s. Independent range selection or autoranging for both capacitance and loss is made using the convenient front-panel push-button controls. Annunciators show the range or mode in use. The bridge will compute and display on command the equivalent series capacitance, series resistance, dissipation (tan δ), or Q of the test. In addition, any capacitance measurement can be displayed as a deviation in capacitance or a percentage deviation versus a previously entered and stored value.

The push button controls have a secondary function when the "entry" mode is selected. In this mode they may be used to program numbers which appear in the right hand display. These numbers may be entered into storage as a reference capacitance value for deviation measurements or entered to set a dc bias voltage on the optional internal supply.

A unique "corrected zero" feature of the 76A supplements the front panel coarse and fine C & G zero controls. In this mode the zero offsets of every combination of C & G range are automatically measured and stored for correction of subsequent readings.

Measurements may be made at the front panel test inputs or at the end of shielded test leads. When "remote test point" is selected a stored program is used to calculate and correct for each measurement made through the 30 inch test cables supplied.

Versatile remote control input and data output options are available.

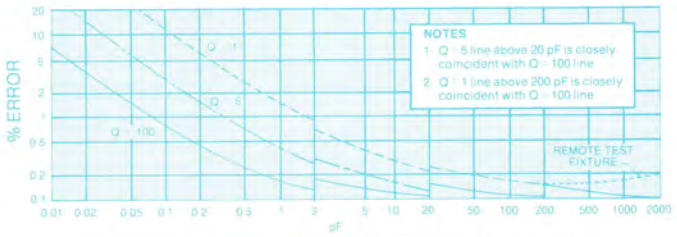
SPECIFICATIONS

Capacitance: 0-2000 pF in 4 ranges:
0-1.9900 pF, 0-19.900 pF, 0-199.00 pF, 0-1990.0 pF

Capacitance Accuracy:

$$\text{C error, (pF)} < \pm \left[\frac{C(pF)}{1000} + \frac{g(\mu S)}{20000} + \frac{C\ fs(pF)}{20000} + 0.0005 \left(\frac{1 + 10D}{1 + D} \right)^2 + \frac{0.02}{e} \right]$$

where e = test level in mV


% ERROR
NOTES
1. Q = 5 line above 20 pF is closely coincident with Q = 100 line
2. Q = 1 line above 200 pF is closely coincident with Q = 100 line
Q = 1
Q = 5
Q = 100
REMOTE TEST FIXTURE
pF

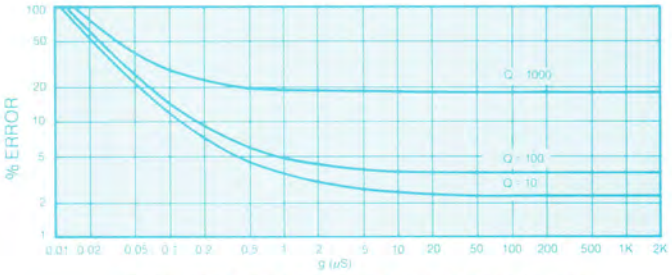
CAPACITANCE ACCURACY (200 mV TEST LEVEL)

Conductance: 0-2000 μS in 4 ranges:
0-1.999 μS, 0-19.99 μS, 0-199.9 μS, 0-1999 μS

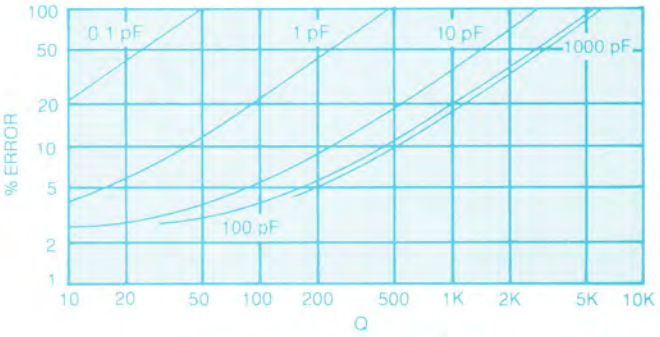
Conductance Accuracy:

$$\text{g error, } (\mu S) < \pm \left[\frac{g(\mu S)}{50} + \frac{C(pF)}{1000} + \frac{g\ fs(\mu S)}{2000} + 0.001 \left(\frac{1 + 10Q}{1 + Q} \right) + \frac{0.2}{e} \right]$$

where e = test level in mV



CONDUCTANCE ACCURACY (200 mV TEST LEVEL)



CONDUCTANCE ACCURACY
IN THE PRESENCE OF CAPACITANCE

Test Signal: 1 MHz, 5-200 mV, variable
Test Time: 100 — 150 ms, C >2 pF and G >2 μS.
500 ms, C <2 pF or G <2 μS.
Display: Dual digital readout, decimal points, units, modes, active ranges.
Display Modes: C_p, C_s, ΔC, Δ%, G, R_p, R_s, D (tan δ), Q.
Autoranging Speed: 5 ms each range change.
Trigger Modes: Continuous (1 per sec), manual, external.
DC Bias: External input, ±200 V, 30 mA fused.
Supplied Accessories: Universal test fixture with 30" input cables Model 76-9A
Available Accessories: 76-2A thru 76-9A, 102-3A (see accessories).

Options:

-01 IEEE 488-1975 Interface Bus.*
-02 Parallel BCD Data Outputs, TTL isolated*
-03 Programmable DC Bias
Range: 0 to 200 volts, unipolar, 5 mA max.
Resolution: 5 mV for bias to 20 volts
50 mV for bias from 20 to 200 volts
Programming: Entered numerically from panel or externally programmed.
Accuracy: 0.05% of setting + resolution
-04 RS-232C Interface*

*May not be installed at the same time.

Capacitance Meters 1 MHz
Model 72 Series

The Model 72 Series of capacitance meters provide rapid, accurate, three-terminal measurements of capacitance, particularly of semiconductor devices because of the low test level employed (15 mV r.m.s.) and the provision for application of dc bias to the test.

The phase-sensitive detection system allows the capacitance of even low Q devices (as low as Q = 1) to be measured with little reduction in accuracy. Range switching is accomplished by a combination of logic-controlled reed relays and diodes. Range selection is by front panel switch or remote TTL inputs.

Both models provide a highly linear, high-speed, dc analog voltage. Output corresponding to the meter or display indication. In addition, the 72BD has BCD outputs, TTL compatible. Autoranging of this model is standard.

Adapters are supplied for coaxial-cable connection and for direct attachment of wire-leaded components.

Data Bus

The Model 72BD may be adapted to the IEEE-488 Standard Data Bus by use of the Model 10A-03 Bus Interface Unit (see page 9).

SPECIFICATIONS

Digital Model 72BD

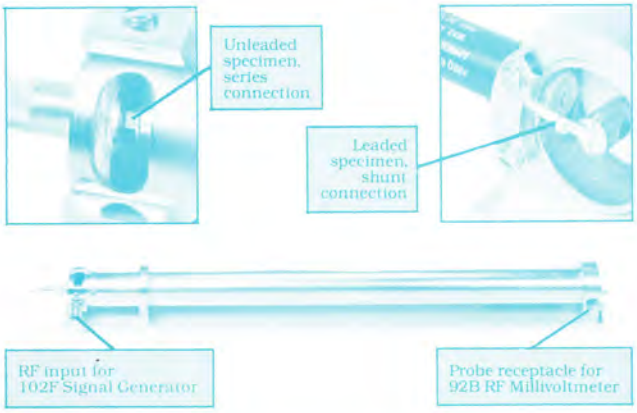
Capacitance Ranges: 2.000, 20.00, 200.0, 2000 pF fs.
Basic Accuracy: ±(0.25% rdg + 0.2% fs).
Display: LED-type, 4 digits.
Data Outputs: Serial by digit, TTL.
Commands: Range (4 lines); manual disable; autorange enable; encode hold, encode trigger; TTL.
DC Output: 2 V for fs all ranges; linearity ±(0.1% rdg + 0.005% fs).
Response time: < 1 ms (50 μs, option −05A)
Test Signal: 1 MHz, 15 mV r.m.s. (100 mV, option −03)
DC Bias: External ±600 V max.
Autoranging: Standard, 100 ms per range.

Analog Model 72B

Capacitance Ranges: 1, 3, 10, 30, 100, 300, 1000, 3000 pF fs.
Basic Accuracy: ±(0.5% rdg + 0.5% fs).
Resolution: 0.5% fs for each range.
Meter: 4½ inch taut-band type.
Commands: Range (8 lines); manual disable; TTL.
DC Output: 1 V for fs (1 series ranges); 3 V for fs (3 series ranges); linearity, ±(0.1% rdg + 0.01% fs)
Response Time: < 1 ms (50 μs, option −05A)
Test Signal: 1 MHz, 15 mV rms. (100 mV, option −03)
DC Bias: External ±600 V max.

Options: See list, page 3
Supplied Accessories: 72-4B Test Post Adapter (BNC)
72-5C Test Post Adaptor (Clips) (see page 19)
Available Accessories: 76-3A, 950030, 950032, 960000, 92-9A (see accessories).

Resonant Coaxial-Line For Q Measurement
Model 34A


Unleaded specimen, series connection
Leaded specimen, shunt connection
RF input for 102F Signal Generator
Probe receptacle for 92B RF Millivoltmeter

The Boonton Model 34A Resonant Coaxial-Line, when coupled to a Model 102 F Signal Generator and a Model 92B RF Millivoltmeter, provides an accurate high frequency system for measuring the effective series resistance (esr), effective capacitance, and Q factor of both leaded and unleaded capacitors.

THEORY

A resonant, coaxial transmission-line, short-circuited at one end and open-circuited at the other, whose fundamental resonant frequency and Q-factor are known, is perturbed with a test component, connected either in series at the short-circuited end of the line, or in shunt at the open-circuited end of the line.

The addition of the component to the line alters the resonant frequency of the system, and the combined Q-factor of the test component and the line is measured using the Δf technique at the newly established resonant frequency. This Q-factor and the parameters of the resonant line, applied in the proper equation, will yield the esr and Q-factor of the test element, as well as the effective capacitance.

COMPONENT CONNECTION

Unleaded chip capacitors are connected in series with the line. Leaded components can also be connected in series with the line and the influence of the leads can be eliminated by swallowing the leads in slots provided in the line (34A-01 version).

Leaded components can alternatively be connected at the open-circuited end of the line to include the effect of the resistance and inductance of the leads.

Special fixtures for radial leaded capacitors and variable piston capacitors are available (see page 18).

ACCURACY AND REPEATABILITY

Error analysis supports absolute accuracy claims of ±10% at Q = 100 to ±30% at Q = 10,000, however, measurements of Q-factors over 1000 may be repeated on a day-to-day basis within a few percent.

SPECIFICATIONS

Range*:
Series mode: 1.0 pF to >1000 pF from 130 to 1250 MHz**
Shunt mode: 0 to 200 pF from 25 to 130 MHz
0 to 100 pF from 265 to 390 MHz
0 to 30 pF from 530 to 650 MHz**
Maximum values of capacitance shown are not absolute limits. No capacitance limit when measuring ESR only.
Test Level:
Series mode: Approximately 5 mA or less
Shunt mode: Approximately 0.4 Volt, or less
Accuracy: Generally within $\pm(5 + Q^{0.35})\%$
Overall length: 24.2 inches (6.15 cm)
Width: 2 inches (5.1 cm)
Height: 2 inches (5.1 cm)
Maximum component body length for series measurements: 0.3 inch (7.6 mm)
Maximum component lead length that can be swallowed for a series measurement: 1 inch (2.54 cm) each lead (34A-01)
Spacing of contacting clamps for shunt measurements: 0.6 inch (1.52 cm)
Minimum component lead length for a shunt measurement: Approximately 0.7 inch (1.78 cm)

Inductance Meter 1 MHz
Model 62AD

The Model 62AD Inductance Meter provides fast, accurate two-terminal, series inductance measurements at 1 MHz with low test current. It is programmable and has a linear, high-speed, dc analog output. The 62AD measures 1 MHz series inductance and ignores any loss component above series Q's of 5. Even if loss appears in parallel with the test specimen, the equivalent series inductance is displayed.

From a normal test open circuit condition dc output responds in less than 200 milliseconds. Autoranging adds another 100 ms per range. From a short-circuited condition, the dc output responds in less than 1 millisecond.

Remote measurements can be made up to 30 inches from the front panel by using the optional 62-1A test fixture.

Data Bus

The Model 62AD may be adapted to the IEEE-488 Standard Data Bus by use of the Model 10A-02 Bus Interface Unit (see page 9).

SPECIFICATIONS

Inductance Ranges: 2.000, 20.00, 200.0, 2000 μH fs
Basic Accuracy: ±(0.5% rdg + 0.2% fs)
Display: LED-type, 4 digits
Data Outputs: Serial by digit, TTL
Commands: Range (4 lines); manual disable; autorange enable; encode hold; encode trigger; TTL
DC Output: 2 V for fs all ranges
Test Signal: 1 MHz; level, 160 μ A max.
Autoranging: Standard, 100 ms per range change.
Options: See list, page 3

Available Accessories: 62-1A, 62-2A, 92-6A, 92-9A, 950030, 950032 (see accessories).

D.C. Range Calibrator
Model 2500

The Model 2500 D.C. Range Calibrator is a precise, highly stable instrument designed for calibrating Boonton Electronics' Model 4200 R.F. Microwattmeter and Model 9200A R.F. Millivoltmeter. It provides the proper voltage levels and source resistances for calibration of each range of both models; its use is fully described in the instruction manuals of the respective instruments.

SPECIFICATIONS

Range	Output Voltage
0	9 μV
1	90 μV
2	900 μV
3	9 mV
4	90 mV
5	900 mV
6A	1.8 V
6B	4.5 V

Accuracy: ±0.15%, all ranges
Source Resistance: Low 900Ω to 1800Ω
300 k 300 kΩ ±2%
500 k 500 kΩ ±2%
Temperature Influence:
Operating: 21°C to 25°C
Non-operating: −20°C to 75°C
Input Power: 100 V, 120 V, 220 V, 240 V, ±10%, 50-400 Hz, 7 VA.
Dimensions: 132 mm high x 211 wide x 292 deep (5.2 in x 8.3 x 11.5).
Weight: 2.7 kg (5.9 lbs.), approx.

Accessories

34-1A High Impedance Probe. For 92B when used as detector for 34A at frequencies above 500 MHz.

34-2A Attenuator Tube. Restricts radiation losses at open end of 34A. Permits accurate measurements above 500 MHz.

34-3A Radial Lead Swallower. Allows quick connection of radial leaded components at open end of 34A without lead influence.

34-3B Radial Lead Swallower (with built-in series capacitor.) For shunt measurement of larger C values at 100, 300, and 550 MHz on 34A.

34-4A Piston Capacitor Adapter. For 34A. Plunger that accepts threaded end of piston capacitor for connection in series with the line. 11/64 inch x 64 threads per inch.

34-4B Piston Capacitor Adapter. For 34A. Plunger that accepts threaded end of piston capacitor for connection in series with the line. 0.120 inch x 80 threads per inch.

34-4C Piston Capacitor Adapter. For 34A. Plunger similar to 34-4A and 34-4B but undrilled.

Accessories

41-2A Detector Cable. 5 ft. special low noise twin cable connects output of 41-4 and 41-5 Series Power Detectors to 42 Series Microwattmeters.

41-4A Power Sensor. For 42B Series. 200 kHz–7 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

41-4B Power Sensor. For 42B Series. 200 kHz–12.4 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

41-4C Power Sensor. For 42B Series. 200 kHz–1 GHz, 1 nW–10 mW, 75 Ω type N, 300 mW cw overload.

41-4E Power Sensor. For 42B Series. 200 kHz–18 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

41-5B Power Sensor. For 42C Series. 200 kHz–12.4 GHz, 10 nW–100 mW, 50 Ω type N, 2 W cw overload.

41-5E Power Sensor. For 42C Series. 200 kHz–18 GHz, 10 nW–100 mW, 50 Ω type N, 2 W cw overload.

62-1A Test Fixture Kit. For 62A Series. Comprises compensated test fixture with 30 inch leads, shorting bar and test clips.

62-2A 1 MHz Inductance Standard. For 62A Series. 3 values in each unit 62-2A/1; 1.2 and 3 μH. 62-2A/2; 10, 20 and 30 μH. 62-2A/3; 100, 200 and 300 μH. Accuracy ±0.5%.

72-4B Test Post Adapter (BNC). For 72 Series. 4 BNC female, test High/Low; differential High/Low.

72-5C Test Post Adapter (CLIPS) for 72 Series. 3 push clips for leaded components High/Low/ground.

76-2A Capacitance Standards. For 72B/BD/C and 76A. Values available from 0 to 1950 pF with residual G readings. For calibrating 76A. Accuracy ± 0.1%.

76-3A Precision Decade Capacitor. For 72 Series and 76A. 1 pF to 1221 pF in 1 pF steps. Accuracy basically 0.1%.

76-4A Conductance Standard. For 76A only. 18 values available from 0 to 1900 μS with residual C readings for calibrating 76A. Accuracy ±2.0%.

76-8A Test Kit. For 76A only. Comprises 17 values of 76-2A and 18 values of 76-4A plus other parts, accessories and test PROMS needed for full C & G calibration of 76A.

76-9A Test Fixture Kit. For 76A. Comprises 76-6A Test Fixture, 30 inch test cables, trigger lead, various adapters and test clips.

82-1A Rack Mount Kit. For 82AD. Two flanges with handles mount to both sides to adapt to 19 inch rack.

82-2A Extender Card. For 82AD. Allows plug-in boards to be operated in elevated position for servicing.

91-4C Low Frequency RF Probe. For all RF Millivoltmeters. 1 kHz to 250 MHz. Overload protection, 10 V ac and 200 V dc.

91-6C Unterminated BNC Adapter. For 91-12F probes. For coaxial connection up to approximately 100 MHz or to 400 MHz when fed from a low impedance source in an electrically-short system. Female.

91-6G Unterminated BNC Adapter. For all probes. Male. Electrically same as 91-6C.

91-7C 100:1 Voltage Divider. For 91-12F probes. Attenuates input signal by a factor of 100 ± (1% + 0.5% per 100 MHz). Measurements to 300 volts, r.m.s. measuring range to 3 volts, 50 kHz to 700 MHz. Maximum input, 1000 volts dc plus peak ac.

Accessories

91-8B 50 Ohm BNC Adapter. For 91-12F probes. For measurements up to 600 MHz in a 50 ohm system. Female. Furnished with Millivoltmeter.

91-8B/1 75 Ohm BNC Adapter. For 91-12F probes. Female.

91-12F RF Probe. For all RF Millivoltmeters except Model 9200A. 10 kHz to 1.2 GHz; useful response for relative measurements to beyond 4 GHz. Overload protection 10 V ac and 400 V dc. Furnished with Millivoltmeter.

91-13B Probe Tip. For 91-12F, 91-4C, and 91-7C. With grounding clip lead for use to approximately 100 MHz. Furnished with Millivoltmeter.

91-14A 50 Ohm N TEE Adapter. For 91-12F RF Probe. Permits connection into 50 ohm line; frequency range to 1.2 GHz. Female/Female.

91-14A/1 75 Ohm N TEE Adapter. Female/Female. For 91-12F RF Probe.

91-14B 50 Ohm N TEE Adapter. Same as 91-14A, except input connector is N male. For 91-12F RF Probe.

91-14B/1 75 Ohm N TEE Adapter. Same as 91-14A/1, except input connector is N male. For 91-12F RF Probe.

91-15A 50 Ohm N Termination. For 91-14A and 91-14B Tee Adapter.

91-15A/1 75 Ohm N Termination. For 91-14A/1 and 91-14B/1 Tee Adapter.

91-16A Unterminated Type N Adapter. For 91-12F probes. For coaxial connection up to approximately 100 MHz or to 400 MHz when fed from a low impedance source in an electrically-short system. Female.

91-18B Storage Container. For Voltmeter accessories.

91-24A 50 Ohm Accessory Kit. Comprises 91-6C, 91-7C, 91-14A, 91-15A, and 91-18B.

91-24A/1 75 Ohm Accessory Kit. Comprises 91-6C, 91-7C, 91-14A/1, 91-15A/1, and 91-18B.

93-1A High Impedance Probe. For 93 Series. 10 MΩ, <11.5 pF input, x 10 attenuation. Six foot lead. Probe tip.

93-2A BCD Serial/Parallel Converter. For 93AD. Plugs on rear of unit. Converts serial data output to parallel BCD, TTL/DTL compatible. Sinks 1.6 mA. 1 inch deep.

102-3A Rack Mounting Brackets. For 102, 103 series, and 76A. L shaped brackets mount both sides to adapt to 19 inch rack.

4200-4A Power Sensor. For 4200. 200 kHz–7 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

4200-4B Power Sensor. For 4200. 200 kHz–12.4 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

4200-4C Power Sensor. For 4200. 200 kHz–1 GHz, 1 nW–10 mW, 75 Ω type N, 300 mW cw overload.

4200-4E Power Sensor. For 4200. 200 kHz–18 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

4200-5B Power Sensor. For 4200. 200 kHz–12.4 GHz, 10 nW–100 mW, 50 Ω type N, 2 W cw overload.

4200-5E Power Sensor. For 4200. 200 kHz–18 GHz, 10 nW–100 mW, 50 Ω type N, 2 W cw overload.

4200-7E Power Sensor. For 4200. 10 MHz–18 GHz, 1 μW–10 mW, 50 Ω type N, 30 mW cw overload.

4210-4A Power Sensor. For 4210. 200 kHz–7 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

4210-4B Power Sensor. For 4210. 200 kHz–12.4 GHz, 1 nW–10 mW, 50Ω type N, 300 mW cw overload.

4210-4C Power Sensor. For 4210. 200 kHz–1 GHz, 1nW–10 mW, 75 Ω type N, 300 mW cw overload.

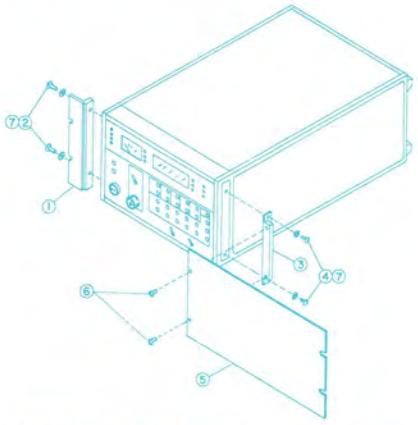
4210-4E Power Sensor. For 4210. 200 kHz–18 GHz, 1 nW–10 mW, 50 Ω type N, 300 mW cw overload.

4210-5B Power Sensor. For 4210. 200 kHz–12.4 GHz, 10 nW–100 mW, 50 Ω type N, 2 W cw overload.

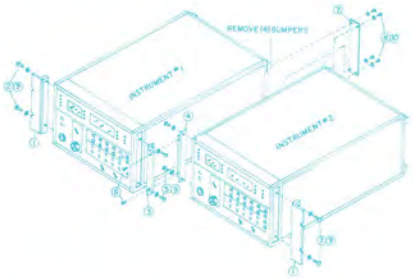
4210-5E Power Sensor. For 4210. 200 kHz–18 GHz, 10 nW–100 mW, 50 Ω type N, 2 W cw overload.

Accessories

4210-7E Power Sensor. For 4210. 10 MHz – 18 GHz, 1 μW – 10 mW, 50 Ω type N, 30 mW cw overload.



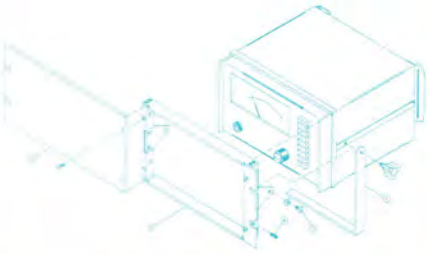
950000 Rack Mounting Kit (Single). For 4200 and 9200. Mounts one unit left or right of blank panel in 19 inch rack. 5.25 inch high.



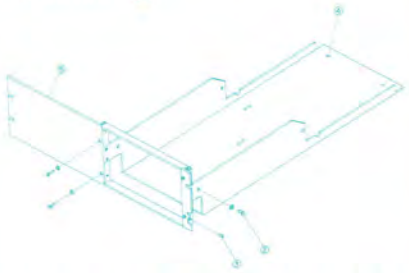
950001 Rack Mounting Kit (Dual). For 4200 and 9200. Mounts two units side by side in 19 inch rack. 5.25 inches high.

950002 Rack Mounting Kit (Dual). For 4200 and 9200. Mounts one unit alongside 25A, 26A, 42, 62, 72, 92, or 93 series.

950030 Rack Mounting Kit (Dual). For 25A and 26A, also 42, 62, 72, 92, and 93 series half rack instruments. Mounts two units side by side. 5.25 inches high.



950032 Rack Mounting Kit (Single). For 25A and 26A, also 42, 62, 72, 92, and 93 series half rack instruments. Mounts one unit to left or right of blank panel. 5.25 inches high.



950033 Rack Mounting Kit (Single). For 42BD, 42CD, 62AD, 72BD, 92BD, and 93AD. Mounts instrument with 10A Bus Interface Unit to rear. Left or right of blank panel. 5.25 inches high, 24.0 inches deep.

950034 Rack Mounting Kit (Dual). For 42BD, 42CD, 62AD, 72BD, 92BD, 93AD. Mounts two instruments with 10A Bus Interface Units to rear. 5.25 inches high, 24.0 inches deep.

950035 Rack Mounting Kit (Single). For 42BD, 42CD, 62AD, 72BD, 92BD, 93AD. Mounts 10A Bus Interface Unit to left or right of instrument. 5.25 inches high, 13 inches deep.

951000 Data Cartridge. For 4200. Used with HP 9825 Calculator for semi-automatic calibration.

952000-1 Data Cartridge. For 9200. Used with HP 9825 Calculator for semi-automatic calibration.

952000-2 Data Cartridge. For 9200A. Used with HP 9825 Calculator for semi-automatic calibration.

952001 RF Probe. For 9200A. 10 kHz to 1.2 GHz. Useful response for relative measurements to beyond 4 GHz. Overload protection to 10 V ac and 400 V dc. Furnished with Millivoltmeter.

952002 50 Ω BNC Female Adapter. For Model 952001 Probe. For measurements to 1.2 GHz in a 50-ohm system.

952003 50 Ω Tee Adapter. For Model 952001 Probe. Permits connection into a 50-ohm line to 1.2 GHz. Type N female/female.

952004 Probe Tip. For Model 952001 Probe. With ground clip lead for use to approximately 100 MHz.

952005 100:1 Voltage Divider. For Model 952001 Probe. Attenuates input signal by a factor of 100. Adds $\pm (1 + f_{MHz}/200)\%$ to instrument uncertainty. For measurements to 300 V (r.m.s. measuring range to 3 V). Frequency range 50 kHz to 700 MHz. Maximum input 1000 V (dc plus peak ac).

Accessories

952006 75 Ω BNC Female Adapter. For Model 952001 Probe. For measurements to 500 MHz in a 75-ohm system.

952007 75 Ω Tee Adapter. For Model 952001 Probe. Permits connection into a 75-ohm line to 1 GHz. Type N female/female.

952008 Unterminated BNC Female Adapter. For Model 952001 Probe. For coaxial connection to approximately 100 MHz, or to 400 MHz if fed from a low impedance source in an electrically-short system.

952009 50 Ω Sensor. For 9200A. Optional 50 Ω terminated sensor for voltage and power measurements, 100 kHz to 2.5 GHz.

952011 50-ohm Accessory Kit. For Model 952001 Probe. Consists of Models 952003, 952005, 952008, 952013, and Model 952014 50-ohm Type N Male Termination.

952012 75-ohm Accessory Kit. For Model 952001 Probe. Consists of Models 952005, 952007, 952008, 952013, and Model 952015 75-ohm Type N Male Termination.

952013 Accessory Case. For Model 952001 Probe and accessories.

954001 Rigid Rack-Mounting Kit. For Models 1020 & 1021. Includes front and rear mounting brackets.

954004 Sliding Rack-Mounting Kit. For Models 1020 & 1021. Permits instrument to be slid out from rack for ease in adjustment.

954005 Rack-Mounting Kit. For Model 8210. Includes handles, angles and flat plates for both sides of instrument.

954006 50 Ohm to 75 Ohm Transformer. For 103A, 103B, 103C, and 103D. 125 kHz to 175 MHz, voltage ratio 0 dB ± 0.3 dB.

960000 Extender Card. For 42, 62, 72, 92, 93, 102, and 103 series. Allows plug-in boards to be operated in elevated position for servicing.

961001 Diagnostic ROM. For 4200-01 and 9200A-01A. Used for signature analysis troubleshooting of unit with IEEE-488 bus interface option.

961003 Diagnostic ROM. For 4200 and 9200A. Used for signature analysis trouble-shooting of unit without IEEE-488 bus interface option.

964001 PCB Extender Card. For Models 1020 & 1021. Allows plug-in boards to be operated in elevated position for servicing.

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